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ORIGINAL ARTICLES

An organizational chart of an Emergency Health Operation Center

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Abstract: *Nowadays, a wide range of natural and man-made disasters, disease outbreaks and pandemics give rise to health emergencies at a global level. Thus, a health security strategy is urgently required through central planning. At the national level, that vision can be implemented with a properly organized and fully functional Emergency Health Operation Center (EHOC). The main executive sections of an EHOC are Command, Planning, Operations, Logistics, Administration, Communications/Intelligence, and Reporting/Briefing. Each of the above sections has several functions and sub-functions, all operating according to a concrete legal basis and detailed operating procedures.*

Keywords: *emergency planning, public health, operation center, health crisis*

INTRODUCTION

In our epoch, due to the extreme complexity of the modern age, natural and man-made threats the management of health crises should imply an effective and integrated action plan, qualified with characteristics that define the effectiveness and success of such a system. An EHOC is such a system that can lead and coordinate the overall national medical response in every emergency incident, especially when involving mass casualties that either exceeds the management capabilities of the nation's health mechanism or disorganize the existing procedures planned for routine conditions. A successful EHOC should be based on two pillars: Legal authority and organizational structure; both will be herein briefly discussed.

DISCUSSION

Legal authority

The legal authority of an EHOC refers to the development of a concrete legislation directive for the public health authorities as regards roles, responsibilities, and coordination with national disaster management resources for legal health operations. That legislation should establish policy guidance, officials of the government and involved organizations, and other executive officers and professionals tasked to provide leadership at a strategic level. The legal authority of an EHOC varies among countries, while the key governmental agencies usually involved are unfortunately often scattered in various Ministries. The long list of those national agencies includes, but is not limited to the following: Fire Brigade; Police; Ministry of National Defence; Coast Guard; Ministry of Transport and Communications; Civil Airlines; Medical School Laboratories; National Public Health Organization; National Center for Emergency Assistance (NCEA); Hospital units (public and private); National Atomic Energy Committee; Forensic Services; Ministry of Foreign Affairs; Non-governmental healthcare and humanitarian responders [1]. The concomitant spread of leadership centers combined with defective multi-ministerial coordination has been proved devastatingly ineffective in the last decades in many environmental or man-made disasters throughout the world. Hence, an EHOC

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must be set under a unified command, a sort of an all-hazard ministry or deputy ministry "of Interior Threats", or "of Civil Protection"; that Ministry can substitute roles, authorities, personnel, and infrastructure of other Ministries and also replace at the highest level both the GSCP and all sorts of emergency committees, mechanisms and operation centers of other Ministries.

Organizational structure

An EHOC should operate within the framework of a thoroughly planned national incident management system, with dedicated personnel and a consolidated operational terminology. Organizational prerequisites for such a system are described in detail in relative handbooks [2-4] and involve at minimum the following executive sections:

1. Command
2. Planning
3. Operations
4. Logistics
5. Administration
6. Communications/Intelligence
7. Reporting/Briefing

The function of an EHOC should be based on competent personnel and equipment installed in a capacious building, consisting of at least an operation-command room, a communication room, and a multipurpose meeting room. The operational doctrine of an EHOC is based on the C4-I principle, i.e. Command – Control – Communication – Coordination – Intelligence. These procedures are prioritized for the planning and response to potential public health risks, albeit they do not replace the daily operational control of resources and services. The goal of C4-I is operational cross-disciplinary coordination at the regional, national and international level and is an integral part of the Concept of Health Operations [5]. Each of the above sections has several functions and sub-functions, (data illustrated in Figure 1), operating according to relevant response actions, called Standard Operating Procedures (SOPs), as described below:

1. Command Section: The EHOC director exerts ex officio the vertical, unified command. He/she is a senior medical officer, with documented expertise in the field of Health Crises and with vast experience in managing complex health operations. The EHOC director will be subordinated to the GSCP and will be supported at his command by a deputy director. Two branches are straight subordinated to the EHOC director:

a) A *Legal Operations Unit* (LOU), staffed by dedicated legal advisers, supports the EHOC leader in taking complicated decisions without unacceptably high legal risks (mainly in emergencies, when some regulations of normal life might need to be temporarily revised or suspended for EHOC operations to be carried out).

b) The *Ancillary Services Unit* (ASU), a supportive bundle of services. Apart from full secretarial support, that unit covers personnel's health, safety and security, cleaning, and janitorial affairs of buildings.

Apart from managing, coordinating, and collaborating skills, the EHOC director must be able to set and follow priorities and optimize results based on available resources. A thorough presentation of the required qualifications of an EHOC director is described by Efstathiou et al [6]. The EHOC director is responsible for the following specific functions:

- The overall operational function and legal responsibility of the EHOC.

- The application of effective command systems, which clearly define roles and responsibilities for all EHOC staff.

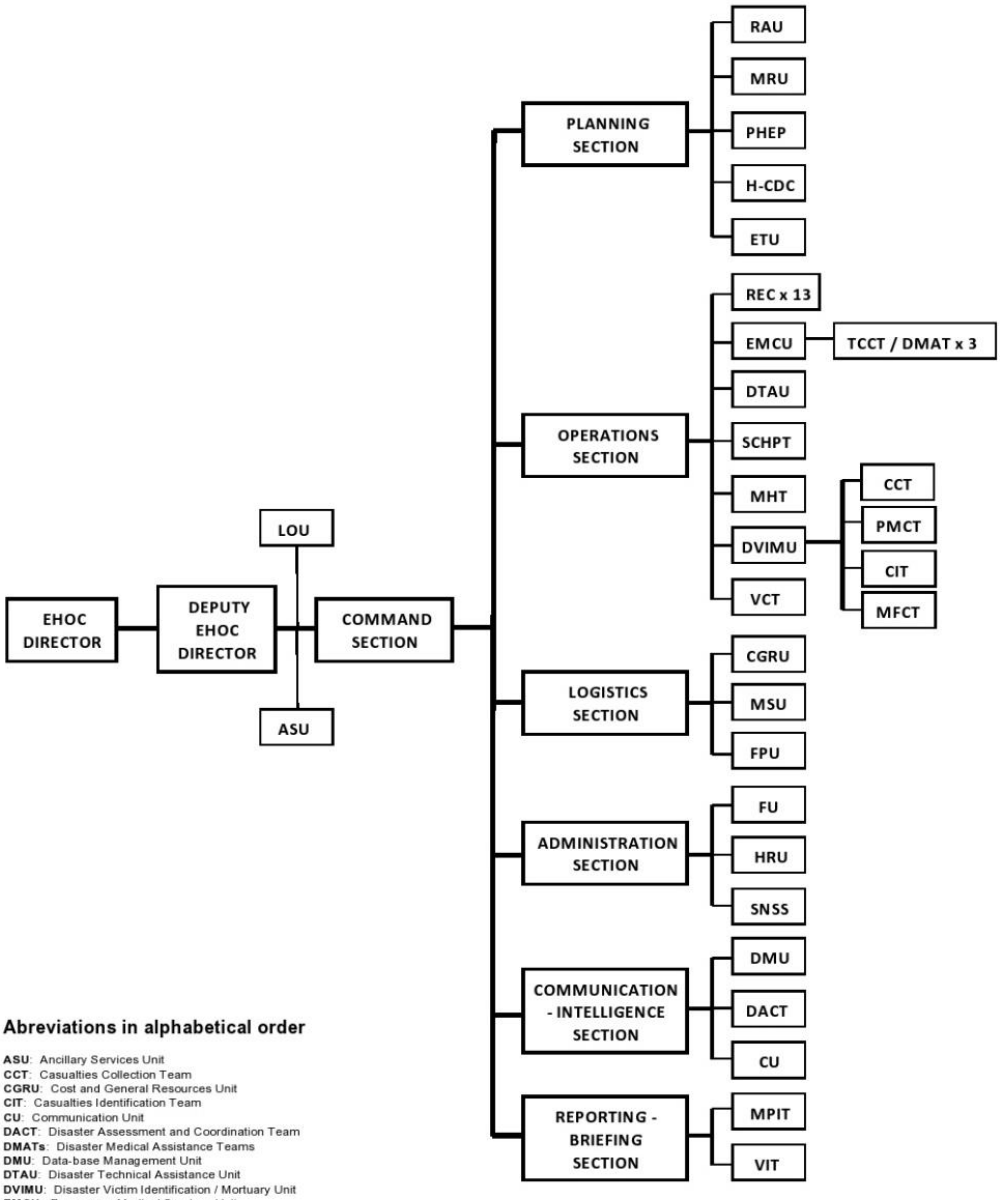
- The final responsibility for verification of any possible health event, mobilization of the national mechanism, and information of government. That highly demanding decision is accomplished through the systematic gathering of relevant information from various sources, such as operational contacts, expert networks, printed reports, and media information.

- The coordination (called "interoperability") among EHOC's sections and also between EHOC as a concrete system and any participant organization, including local and private agencies, when a major health incident/operation takes place. As major participants, apart from the national agencies are considered the following international stakeholders:

- Center for Disease Control and Prevention (CDC), with worldwide action; a European-CDC, as well as national CDCs also exist (Planning Section, bellow).
- Monitoring and Information Center (MIC): The operational heart of the United Nations Health Security Committee; mobilizes international aid for mass disaster incidents.
- World Health Organization (WHO): Provides the ultimate health assistance worldwide.
- North Atlantic Treaty Organization (NATO): An intergovernmental military alliance, also providing some specific health standardization agreements (STANAGs).

2. Planning Section: It emphasizes coordination, interoperability, and cooperative team working through relevant SOPs, with the following branches and sub-functions:

Figure 1: Organizational structure of an EHOC



Abreviations in alphabetical order

ASU: Ancillary Services Unit
CCT: Casualties Collection Team
CGRU: Cost and General Resources Unit
CIT: Casualties Identification Team
CU: Communication Unit
DACT: Disaster Assessment and Coordination Team
DMATs: Disaster Medical Assistance Teams
DMU: Data-base Management Unit
DTAU: Disaster Technical Assistance Unit
DVIMU: Disaster Victim Identification / Mortuary Unit
EMCU: Emergency Medical Services Unit
ETU: Exercises and Training Unit
FPU: Food Provisions Unit
FU: Facility Unit
H-CDC: Hellenic Disease Control and Prevention Unit
HRU: Human Resources Unit
LOU: Legal Operations Unit
MFCT: Mass Fatality Care Team
MHT: Mental Health Team
MPIT: Media and Public Information Team
MRU: Medical Resource Unit
MSU: Medical Supplies Unit
PHEP: Public Health Emergency Response Planning Unit
PMCT: Post-mortem data Collection Team
RAU: Risk Assessment Unit
RECs: Regional Emergency Coordinators
SCHPT: Shelter Care and Humanitarian Priorities Team
SNSS: Strategic National Sanitary Stockpile
TCCTs: Trauma and Critical Care Teams
VCT: Veterinary Care Team
VIT: Victim Information Team

a) *Risk Assessment Unit* (RAU); as a component of a comprehensive risk management program, RAU conducts hazard-specific vulnerability analyses according to the following flow-chart: Information gathering – data analysis – assessment – prioritization of actions – follow up of resultant outcome.

b) *Medical Resource Unit* (MRU); it predicts the local needs

in medical resources, supervises hospital operation in emergency status, and registers medical devices, pharmaceutical stock, beds and bedding, laboratory capabilities, supplies and reserves, personal safety equipment, bio-safety facilities, etc.

c) *Public Health Emergency Planning Unit* (PHEP); it devises hazard generated procedures, priorities and risks, preparedness programs, and all relevant SOPs, both hazard- and response-specific, in a form of an operation manual or handbook. Expected activities are described in flow-chart diagrams and regard all actions to take place from the first hour up to several weeks after the incident. Such SOPs exist for all levels of response and describe, among others, personnel, equipment, supplies and also define operational time points. In their standard form, SOPs include a basic plan describing current legislation, operational phases, and appendices describing incident functions, response specific and deactivation plans, checklists, templates, job cards, resources, and relevant literature [7].

d) *Disease Control and Prevention Unit* (CDC); the national link to the European-CDC.

e) *Exercises and Training Unit* (ETU) for continuous and efficient training of the EHOC staff according to international standards [8]; ETU also conducts preparatory planning for future emergency response scenarios, reviews existing national and international regulations, frameworks, and planning guidelines, and organizes periodically full-scale exercises on a realistic base. A final goal for ETU is an overall improvement of awareness, competence, operational readiness, and continuous updating of plans and procedures.

3. Operations Section: The cardinal EHOC branch comprises preparedness and response activities provided by trained personnel capable of responding within two hours after identification of a major health incident. Specific SOPs are:

- Gathering and analyzing all relevant pieces of information.
- Stepwise analysis and evaluation of all factors affecting the mission; in these are included not only medical factors but also general ones (environment, weather conditions, available time, humanitarian implications, cooperation reluctance or conflict of interest among various public and private participants, staff security, etc).
- Consideration of all alternative case-based actions; that is called mitigation, i.e. threat/hazard/disease-specific, on occasion, actions to minimize health-related impact after hazard occurrence.
- Activation of preparedness levels, from Level 3 (lowest) up to Level 1 (highest), according to the existing situation after interaction with bio-surveillance laboratories network and with the national response framework given by GSCP. The preparedness SOPs include a detailed and continuously updated catalog of involved personnel, methods of fast recall on a 24h/7d basis, key-persons, and all other necessary details of an early warning protocol.
- Flexibility, surge capacity, i.e. ability to respond in multiple emergency health incidents, surge capability, i.e. ability to cope with unusual/special medical needs, and adequate durability, i.e. long-lasting response [9].
- Close collaboration and engagement with scientific entities in strategic preparedness and tactical operations, such as associates from the academic world, seismologists, meteorologists, building engineers, forensic scientists, laboratory experts, anthropologists, epidemiologists, etc.
- Linkage and integration of healthcare volunteers, non-governmental organizations, and major humanitarian responders, e.g. Red Cross.
- Recovery actions at multiple levels, which restore the stricken environment to as close to former “normal” status after a major health incident.
- Promotion of environmental health, social engagement, mobilization, and solidarity of the community.

Hence, according to the above functions the Health Operations Section acts in the following response stages: Incident recognition – Notification – Activation – Mobilization – Operations – Demobilization - Transition to recovery. The Operations Section is divided into several branches [9], as follows:

a) *Regional Emergency Coordinators* (RECs), acting as operational liaisons between central EHOC and the corresponding regional departments of Civil Protection for each of the administrative districts of the nation’s territory; for each REC there should be established a mobile (in a vehicle) operation center with satellite intercommunication with the regional Civil Protection liaison.

b) An *Emergency Medical Services Unit* (EMCU); which is a field-level rapid deployment medical force subdivided into three (3) Trauma and Critical Care Teams (TCCTs). Depending on the incident, these teams can be reorganized in equipment and staffing to Disaster Medical Assistance Teams (DMATs) [10]. DMATs provide primary and acute care, triage of mass casualties, initial resuscitation and stabilization, advanced life support, and preparation of sick or injured for evacuation. All victims are managed by use of the internationally standardized procedure of colored cards which illustrate a brief medical history and mainly the medical priority for each victim (by the respective color). After prompt evacuation from the disaster area (when it is such), a rapid pre-hospital triage, followed by emergency initial stabilization and then by urgent transport of casualties

constitutes the operational "holy trinity" for these teams. At the disaster point the TCCT/DMAT leader should be the first official responder who will undertake the following SOPs:

- Rapid estimation of hazard situation on the operation field along with an estimation of a probable number of casualties.
- Prompt notification to his/her superiors about urgent requirements in staff and equipment (ambulances, bedding, paramedics, body bags for fatalities, cold storage facilities, drinking water supply, etc.).
- Together with the (non-medical) on-site delegate of Civil Protection, they immediately delineate operational disaster zones around the disaster point.
- Outside the "hot zone" the above two operational delegates minister to the needs of less injured victims; the TCCT/DMAT leader, in particular, activates the operational teams of sub-paragraphs (c-g) of the EHOC Operation Section (described below).
- Remains in the "hot zone" and coordinates the rescue teams until he/she receives a replacement order.

c) A *Disaster Technical Assistance Unit* (DTAU), consisting of non-medical technical specialists who will provide, support, and repair mechanical and electrical equipment of operation.

d) A *Shelter Care and Humanitarian Priorities Team* (SCHPT); it coordinates humanitarian affairs, especially of the more vulnerable population groups, and prioritizes on-site non-medical, but still life-threatening needs that can heavily affect a disaster area, such as shelter, covers, safety, nutrition, drinkable water, etc. This unit cooperates with the Construction/Engineering Branch of the Civil Protection for shelters and sanitation systems construction.

e) A *Mental Health Team* (MHT), consisting of psychiatrists, psychologists, and social workers. They assess early post-disaster stress within the affected population and responders and support their mental health status by interventional and/or pharmaceutical practices and by cooperation with corresponding church/religion representatives.

f) A *Disaster Victim Identification/Mortuary Unit* (DVIMU); provides expertise, technical assistance, and support for casualties and human remains documentation, in collaboration with the Reporting/Briefing Section of the EHOC (described below). The unit further develops four operational branches; the Casualties Collection Team (employs laborers), the Post-mortem data Collection Team (collects and evaluates fingerprints, DNA/dental samples, etc, for forensic medicine purposes), the Casualties Identification Team, and the Mass Fatality Care Team (offers disaster mortuary services).

g) A *Veterinary Care Team* (VCT); offers care to animal casualties and to operating animals (e.g. rescue dogs), using veterinary medical support, equipment, supplies, and pharmaceuticals.

4. Logistics Section: It determines and supervises the provision of emergency resource needs for the unceasing operational function of the EHOC on a 24h/7d basis. It is divided into the following branches:

a) *Cost and General Resources Unit* (CGRU); it monitors cash flow and expenses and coordinates all sources of funding. Additionally, it can provide direct cash from a special account for immediate access in urgent needs of high priority, thus avoiding time-consuming bureaucracy.

b) *Medical Supplies Unit* (MSU); it monitors needs and provides required quantities of medical and pharmaceutical supplies as well as personal protective equipment for frontline health care workers.

c) *Food Provisions Unit* (FPU); it provides all services, resources, and supplies regarding nutrition to operation needs and also ensures that operating EHOC personnel have sufficient supplies of food and drinkable water.

5. Administration Section: It provides facility systems and supports the overall physical infrastructure (premises, furniture, equipment, etc.) of the EHOC; The section is divided into the following branches:

a) *Facility Unit* (FU); it organizes building and sectional layout of EHOC units in dedicated, purpose-built facilities, with adequate space for its staff, physically and environmentally secure, accessible, and survivable in the event of a threat or disaster.

b) *Human Resources Unit* (HRU); it formulates job descriptions and classifies staff requirements based on the knowledge, skills, and abilities required for the role and function of each person in the EHOC.

c) *Strategic National Sanitary Stockpile* (SNSS); it develops and deals with the national repository of basic life-support medications (antibiotics, antidotes, etc) and surgical supplies for any nation-wide event of a mass health emergency.

6. Communications/Intelligence Section: The equipment of that sector includes high technology infrastructure (computers, servers, internet stations, software, etc.) and all tools available to support an effective, all-weather-resistant continuous communication and data management according to high-level privacy and security standards. Of utmost importance is the timely, efficient, and accurate information flow on a 24 hour/7 day basis, between the Command section and each of the corresponding field-units

from the Operations sector. For that to be accomplished a sophisticated web-based digital tool allowing fast, real-time information sharing to multiple recipients is constantly in function. Some specific sub-functions of that section are:

- A continuous surveillance system, for gathering and exchanging information about sensitive civil national territories (e.g. cities and forest areas), by use of a broad camera-surveillance network and by electronic processing of the data-flow from an advanced, interactive mapping application. The relevant SOPs address all kinds of environmental and man-made threats, monitoring procedures, and actions according to certain hazard thresholds.
- An internet monitoring and medical intelligence/analysis system that verifies information to prevent duplication/ contradictory data collection.
- A rapid early warning/alert system triggering the coordinated rapid recall of staff back to their positions.
- A classified and secure web-based priority system for high-level communication and providing of information among national and transnational decision-makers.

The Communications/Intelligence sector is divided into the following branches:

a) *Data-base Management Unit* (DMU); it controls and centralizes information distribution to appropriate stakeholders for coordinated resource mobilization and correct decision-making to a wide range of emergencies.

b) *Disaster Assessment and Coordination Team* (DACT); it links the abovementioned data with relevant colleagues and experts from both country-level contacts and from the European Monitoring and Information Centre (MIC), as well as from UN/WHO.

c) *Communication Unit* (CU), equipped with telecommunication infrastructure and emergency communication services for sharing urgent relevant information among operational delegates from national and European governmental and private health agencies.

7. Reporting/Briefing Section: Chief is a senior Public Information Officer with pronounced communication skills to prevent inaccurate information spreading and panic diffusion, thus public composure and confidence to be preserved. The chief of the section applies uniform medical reporting SOPs according to the basic requirements: Who – when – where - what and how to report. The Reporting / Briefing section is divided into two branches:

a) *Media and Public Information Team* (MPIT), for regular management of the media and consequently of public expectations for the incident, by the timely transmission of valid information, carefully filtrated for any confidential or higher classified evidence.

b) *Victim Information Team* (VIT); it acts as the liaison between the afflicted population (victims or their families) and state authorities to serve their needs, to manage the list of missing persons, and to provide discreet information, in cooperation with DVIMU and MFCT of the Operations Section. The VIT also formulates antemortem medical records for the deceased and provides forensic support by coordination with local and national law enforcement agencies.

CONCLUSIONS

Albeit the proper function of an EHOC depends on numerous factors, qualifications, and principles, only two ones can be regarded as primary; first, the political will to radically reform the national and trans-national administrative "status quo" at the highest level, so that various authorities to be centralized under the same command through an appropriate legislative framework and second, a properly structured and fully functional organizational plan of an exemplary EHOC.

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References:

1. Tsouros, AD and Efstathiou, PA (2007) Mass Gatherings and Public Health: The Experience of the Athens 2004 Olympic Games. WHO. ISBN: 9789289072885.

2. World Health Organization (2015a) Summary report of systematic reviews for public health emergency operations centers. Plans and procedures; communication technology and infrastructure; minimum datasets and standards;

3. World Health Organization (2017) Emergency response framework – 2nd ed. WHO, Switzerland. ISBN 978-92-4-151229-9.

4. World Health Organization (2018) Handbook for Developing a Public Health Emergency Operations Centre (PHEOC) Part A: Policies, Plans and Procedures. WHO, Switzerland, ISBN 978-92-4-151512-2

5. Endericks, T (2015). Public health for mass gatherings: key considerations. ISBN 978920694385. WHO

6. Efstathiou, P. et al. (2009) Crisis management in the Health Sector; Qualities and characteristics of health crisis managers. International Journal of Caring Sciences. September-December, Vol 2, Issue 3, pp. 105-107.

7. World Health Organization (2015) First consultation meeting on a

framework for public health emergency operations centres. Meeting Report Geneva, Switzerland 27-29 April 2015.

8. World Health Organization (2018) Handbook for developing a Public Health Emergency Operations Centre Part C: Training and Exercises. WHO, Switzerland, ISBN 978-92-4-151513-9

9. Barbera, J. and Macintyre, A. (2007) Medical Surge Capacity and Capability: A Management System for Integrating Medical and Health Resources During Large-Scale Emergencies. 2nd ed. CNA Corporation: Institute for Public Research.

10. Balajee, S et al. (2017) Sustainable Model for Public Health Operations Centers for Global Settings. Emerging Infectious Diseases. December 2017 (sup), Vol. 23, pp. 190-195